



# 2021 Cleanup Progress

Annual Report on Oak Ridge  
Reservation Cleanup



# Message from the Manager

## DOE Oak Ridge Office of Environmental Management

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To the Oak Ridge Regional Community:

Another year is in the books, and the U.S. Department of Energy's Oak Ridge Office of Environmental Management (OREM) is proud to share updates about the impressive transformation and environmental cleanup progress happening across the Oak Ridge Reservation.

Last year, we completed DOE's largest-ever cleanup effort and became the first site in the world to remove an entire uranium enrichment complex. Now, a new chapter of cleanup is underway, and we have transitioned the skilled, experienced workforce responsible for our historic success at the East Tennessee Technology Park (ETTP) to projects at the Oak Ridge National Laboratory (ORNL) and Y-12 National Security Complex (Y-12).

In 2021, we finished tearing down the former Biology Complex at Y-12. This high-priority project involved tearing down the massive six-story, 255,000 square-foot Building 9207 and the three-story, 65,000-square-foot Building 9210. These were the final two structures remaining from the original 11-building complex that dated back to the 1940s. This effort eliminated deteriorating, high-risk facilities, and it cleared an 18-acre area that Y-12 will reuse to support national security missions.



Crews also demolished the Tritium Target Preparation Facility and former Radiological Development Lab's West Cell Bank at ORNL this year. These projects also eliminated high-risk contaminated structures and opened space for future research missions at the site.

In addition to these teardowns, employees spent this year preparing many more buildings for demolition at ORNL and Y-12, including former research reactors, uranium processing facilities, isotope and fission development laboratories, and support buildings. Our work is reducing risks, stabilizing facilities, and paving the way for large-scale demolition that will enhance safety and provide land for expanding research and national security missions.

OREM is also focused on reducing Oak Ridge's inventory of nuclear waste and made significant strides in 2021. Workers completed processing the remaining low-dose inventory of uranium-233 stored at ORNL and shipped the material for safe, permanent disposal offsite. We also hit a milestone related to disposing the inventory of transuranic waste. Since shipments resumed to the Waste Isolation Pilot Plant, more than 100 shipments have been completed from Oak Ridge, representing a 50% reduction in the inventory stored onsite.

This year we maintained our investments in infrastructure projects that lay the groundwork for future cleanup. Construction is ongoing on the Outfall 200 Mercury Treatment Facility, which is a linchpin project for Y-12's cleanup. When operational in 2025, it will open the door for demolition of Y-12's large, mercury-contaminated facilities and subsequent soil remediation by preventing potential mercury releases into the nearby creek. OREM is also investing \$27 million to upgrade and extend the life of a waste treatment system that is critical to ongoing cleanup and research missions at ORNL.

We are incredibly grateful for the support and involvement we enjoy from the community, and we are committed to collaborating with these local partners and stakeholders and being responsible stewards of taxpayer dollars by completing our projects on time and on budget. Thank you for your role in helping advance cleanup in Oak Ridge, and we look forward to another productive year ahead.

Jay Mullis



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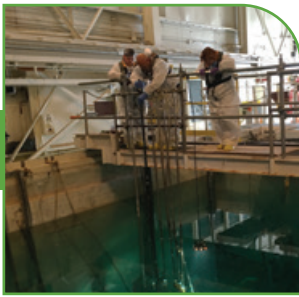
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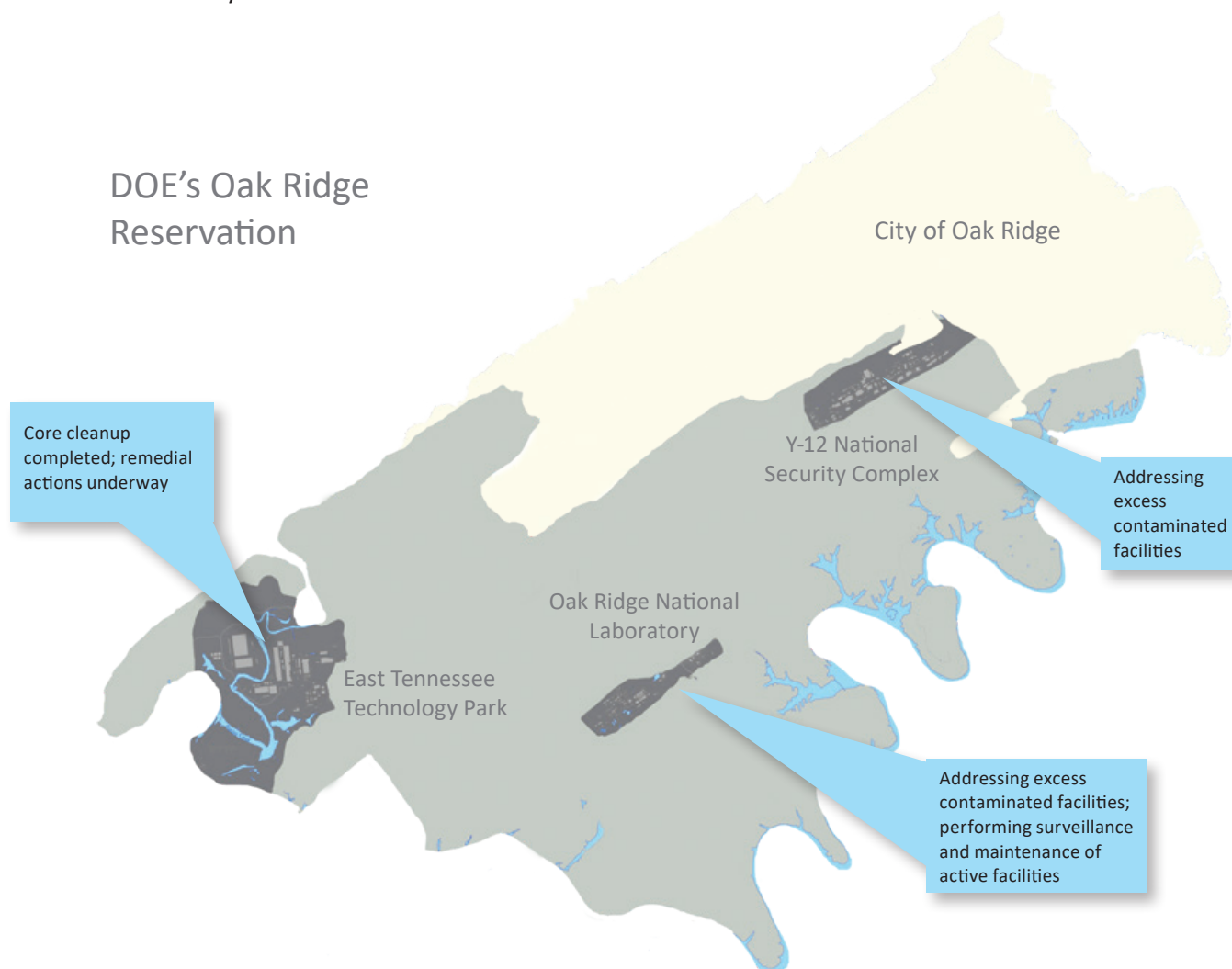
# Introduction

In FY 2021, cleanup at Oak Ridge National Laboratory and the Y-12 National Security Complex moved to the forefront with core cleanup completed at East Tennessee Technology Park. These risk reduction activities included stabilizing and preparing numerous excess contaminated facilities for demolition, as well as demolishing structures that were demolition-ready. At ETPP, work continued on performing necessary remedial actions to continue the site's transformation to a multi-use industrial park, national park, and recreational area.

The Oak Ridge Reservation has played key roles in our nation's defense and energy research. However, past waste disposal practices and unintentional releases have left portions of the land and facilities contaminated and in need of environmental cleanup. The contaminated areas of the reservation are on the U.S. Environmental Protection Agency's (EPA) National Priorities List, which includes sites across the nation that require cleanup under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). These areas on the Oak Ridge Reservation have been clearly defined, and OREM is working to clean and restore them under a partnership with the EPA and the Tennessee Department of Environment and Conservation (TDEC).



Together, through the support provided by contractors, unions, Congress, and elected officials, OREM is enhancing safety, removing barriers to economic development, and enabling vital missions in science, energy, and national security.





## East Tennessee Technology Park

The former Oak Ridge Gaseous Diffusion Plant began operations during World War II as part of the Manhattan Project. Its original mission was to produce enriched uranium for use in atomic weapons. The 2,200-acre plant was shut down permanently in 1987. Core cleanup of the site was completed in 2020 and remedial actions are now underway, facilitating the site's transformation into a multi-use industrial park.

# Centrifuge Complex slab removal completed

It once housed one of the tallest and most visible buildings at ETPP, and now the property where the Centrifuge Complex stood is a cleared site ready for industrial development.

The Centrifuge Complex was one of the final buildings demolished as workers completed the historic, first-ever cleanup of a gaseous diffusion plant in 2020. Left behind after that cleanup was a large concrete slab that sat under the 235,000-square-foot facility. Workers with cleanup contractor UCOR, an Amentum-led partnership with Jacobs, completed removing that slab and backfilling the site.

The Centrifuge Complex was built in stages to provide development, testing, reliability, and demonstration

capability of uranium enrichment using centrifuges. The last of these facilities ceased operation in the mid-1980s.

The facility's footprint falls in the proposed area for a new regional airport that is being planned at ETPP. Approximately 65,000 cubic yards of backfill soil was brought in to complete the Centrifuge Complex area site restoration. More than 30,000 cubic yards of that came from a soil borrow area located where the site's former Powerhouse facilities stood. Using that soil as backfill rather than purchasing it commercially saved almost \$200,000.

The Centrifuge site will remain a grassy field until plans move forward on the proposed airport.



Excavation at the former Centrifuge Complex site

At right, the Centrifuge site before demolition. Below are photos showing slab removal in progress and the completed site, which is part of the footprint of a proposed regional airport.



# Remediation completed at former Powerhouse Area

Once home to a massive power plant and oil tanks, and later used as a waste storage site, the former Powerhouse area at ETTP is now a clean, grassy field primed for future recreational use.

Cleanup contractor UCOR completed backfilling and contouring a 21-acre section of the area that had been used to store scrap metal from ETTP, Y-12 National Security Complex, and Oak Ridge National Laboratory. Removal of almost 50,000 tons of scrap metal from that site was completed in 2007, followed by removal of contaminated soil.

The recent backfill and contouring project directs water to wetlands and the nearby Clinch River, leaving behind a swath of land that has been proposed for future recreational development. More than 76,000 cubic yards of backfill and almost 27,000 cubic yards of topsoil were placed at the site.

This project follows a similar one earlier in the year in which a two-foot soil cover was placed on an adjacent

9-acre site that housed oil tanks associated with the Powerhouse. An innovative GPS system was used on this and the 21-acre project to ensure appropriate soil placement and contouring. This technology aided workers as they conducted the project, and it ensured all areas received two feet of soil cover.

The GPS system, which works both as a handheld device and as equipment installed on the soil-moving vehicles, maps out all the contours and lets workers know how much soil is needed to ensure a continuous two-foot cover. The technology requires less dirt, saving significant money. This type of coverage also facilitates proper drainage by maintaining the site's contours.

OREM is also working to get an interim Record of Decision (ROD) in place to address groundwater cleanup at the site. RODs document the cleanup approach that will be used. This ROD will accompany two existing RODs addressing soil remediation of the main plant and the area surrounding it.



Backfilling at the former Powerhouse area

The innovative GPS system allowed for precise soil placement, reducing the amount of soil needed and saving costs. The system includes both handheld and equipment-mounted technology.



The Powerhouse area during early operations (left) and the completed remediated site (below)



# Various soil cleanup projects underway

Soil remediation at ETPP is helping to eliminate hazards at the site and pave the way for its future industrial and recreational use.

ETPP is divided into two cleanup regions: Zone 1, a 1,400-acre area outside the main plant, and Zone 2, an 800-acre area that comprises the main plant area. The areas in these zones are divided into varying-sized exposure units (EUs) for the purpose of remediation.

## Zone 1

The Interim Record of Decision (ROD), which documents the cleanup method for Zone 1, requires OREM to remediate soil for the protection of groundwater and a future industrial workforce and includes land use controls. An Amendment to the Interim ROD in 2020 added cleanup goals for the protection of terrestrial (land-based) ecological receptors. It also identified recreational land uses for portions of Zone 1. The ROD divides Zone 1 into 80 EUs that range in size from 4 to 66 acres.

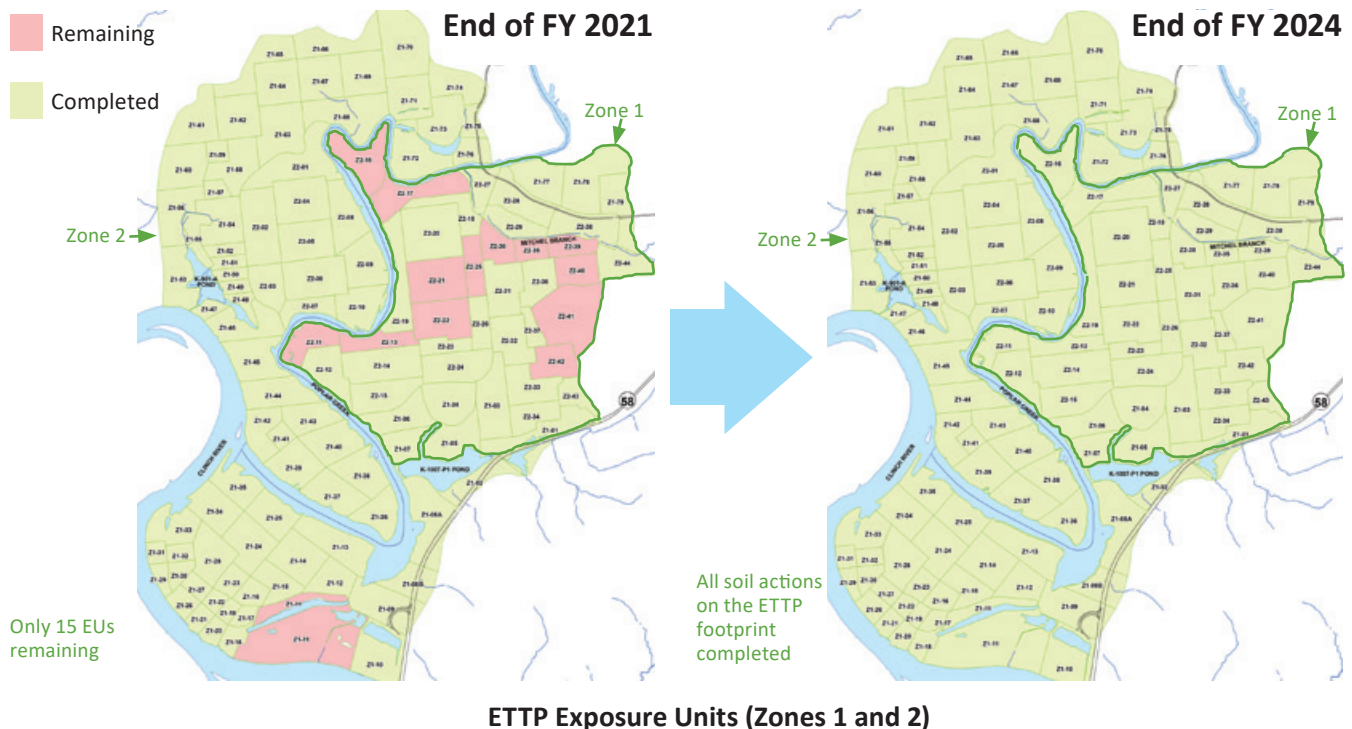
In FY 2021, OREM completed remedial actions in four Zone 1 areas to eliminate ecological risk to wildlife: the K-901 Drainage Ditch and North Disposal Area, K-1085, Blair Quarry, and K-722 Powerhouse Area.

## Zone 2

The Zone 2 ROD requires OREM to remediate soil for the protection of groundwater and a future industrial workforce and includes land use controls. It divides Zone 2 into 44 EUs ranging in size from 6 to 38 acres.

In FY 2021, OREM and UCOR excavated and removed soil contaminated with uranium and other radiological contaminants in EU-19, which lies immediately west of the former K-25 Building, and at the former K-1303 facility in EU-30. Additional soil actions were completed for the protection of groundwater in areas with volatile organic compound contamination near the former K-1423 facility (EU-25) and in the former Central Neutralization Facility (EU-35). Soil remedial actions for the protection of groundwater began at two additional sites with volatile organic compound contamination, one located inside the “U” shape of the former K-25 facility in EU-21 and a second area in EU-25, at the former K-1413 facility.

A number of concrete slabs were removed as part of the Zone 2 ROD implementation, most notably the former Centrifuge Complex slabs in EU-42. Additional slabs that were removed included K-1036-A, the K-1024 slab, and the K-1025 A-E slabs.





Workers excavate contaminated soil and package it for shipment. Workers performing remedial activities across the ETPP site are removing contaminated soil and replacing it with clean backfill.



## Small scale demolition projects completed

All major facilities at ETPP were demolished as part of DOE's Vision 2020 effort to complete core cleanup by the year 2020. However, various minor structures remained after ETPP cleanup was completed. Several of these structures, such as a water tank on McKinney Ridge, Central Receiving Facility, and a meteorological tower, were demolished.



**Demolition of a meteorological tower**



**Demolition of the Central Receiving Facility**



**Demolition of the McKinney Ridge water tank**

# Industrial and recreational development move to the forefront as ETPP continues transformation

Oak Ridge's Reindustrialization Program entered its 25th year as the model DOE asset reuse program. During that time, OREM has been transforming ETPP from a former government-owned uranium enrichment complex into a multi-use industrial business park that includes national historic preservation and conservation and greenspace areas. OREM has successfully transferred almost 1,300 acres at ETPP for beneficial reuse and is working to complete transfer of the remaining acreage at the site.

During FY 2021, the Reindustrialization team completed the transfers of Portal 4 to the Community Reuse Organization of East Tennessee (CROET) and Portal 11 and adjacent land to the City of Oak Ridge. OREM also continued to progress the transfer of additional areas of ETPP, including a former switchyard, the former K-1037 area, and the former Toxic Substances Control Act Incinerator Area. These parcels will further economic development and expand support of city services.

The team also continued to support the city's general aviation airport project, which is currently in the planning stages to be constructed along Highway

58 in the front area of the ETPP site. Additionally, OREM and UCOR supported CROET in their sale of the former K-31/K-33 area which brings a new company and investment to the area. Kairos Power, an advanced nuclear engineering company, will invest \$100 million and create 55 jobs to deploy a demonstration reactor where a massive enrichment building once stood. The company plans to develop technology to provide carbon-free, affordable energy to the U.S. electricity market.

The focus also continued on finding opportunities to enrich the community and enhance public recreation opportunities at ETPP. The partnership between the Tennessee Wildlife Resources Agency (TWRA) and DOE is resulting in a plan to transfer hundreds of acres for greenspace and mixed-use recreational areas.

The site continues to see real progress toward transformation. A new End State and Closure Plan was developed in 2021 to address the remaining scope of work and necessary land transfers as well as provide a vision for how the site will look in the future.



**Artist's renderings of the future ETPP site**





ETPP before cleanup



Future vision of the ETPP site



## Oak Ridge National Laboratory

The Oak Ridge National Laboratory is DOE's largest multi-program national laboratory that conducts cutting-edge research in energy, materials and chemical sciences, nuclear science, and supercomputing. However, the site also houses numerous old, contaminated buildings and forms of waste from previous research and operations in past decades.

# Reactor pool drained after components removed

To prepare for near-term demolition, highly radioactive components were removed from the Bulk Shielding Reactor pool. Workers then drained 130,000 gallons of water from the pool.

This effort is a crucial step for the demolition of the facility, also known as Building 3010. It is an aging, contaminated structure that no longer supports DOE's current day research missions.

To remove the irradiated materials, UCOR moved a 6,100-pound waste transfer liner to a 21-foot depth in the pool. Workers placed the irradiated materials into the waste transfer liner and sealed it, lifted it from the pool, placed into a waste disposal liner, and moved it into an 88,000-pound transport cask. Then it was shipped safely for offsite disposal.

The Bulk Shielding Reactor was initially constructed in 1950 to lead groundbreaking aircraft radiation protection research as part of the government's Aircraft Nuclear Propulsion Program. This program was one of the earliest research and development

initiatives to identify peaceful uses of atomic energy after World War II.

Workers researched various designs and configurations to protect crew members from radiation in a proposed nuclear-powered aircraft. The facility also housed a low-power reactor that was used to train reactor operators and provide hands-on experience for college students until it was shut down in 1987.

The facility was one of more than a dozen research reactors constructed at ORNL over multiple decades. Each contributed to ORNL's reputation as a world leader in cutting edge nuclear research and development. EM's current phase of cleanup is focused on safely clearing away these excess contaminated facilities to eliminate risks and clear land for future research missions.

The Bulk Shielding Reactor is one of 16 inactive research reactor and isotope facilities EM is currently addressing at ORNL.

**Cask with removed components being readied for loading onto transport truck**





Workers survey the 3010 reactor pool

# 3026 hot cell demolished, final cell being prepped

One of the final two hot cells that were part of the former Radioisotope Development Laboratory at ORNL was demolished. Crews were characterizing the final hot cell at the end of the fiscal year in preparation for demolition.

The remaining cell and the five others that were previously demolished were heavily shielded concrete rooms that provided researchers protection from radioactive material as they conducted research. The Radioisotope Development Laboratory was originally built in 1945 to support isotope separation and packaging, but it was later used to examine irradiated

reactor fuel experiments and components. The outer structure and four of the facility's cells were demolished a few years ago, and another cell was demolished by cleanup contractor UCOR during FY 2021.

Characterizing the remaining hot cell involves identifying the radiological and hazardous contamination within, which allows workers to plan deactivation of the structure. This work is being conducted under a six-story protective cover structure to ensure nearby facilities aren't impacted by this work.



**Demolition of a hot cell (above). An innovative rail system was built (right) to transport waste out of the protective cover structure.**



# Deactivation an important step to eventual demolition of several excess contaminated facilities

Workers continued to conduct deactivation operations in various unneeded ORNL facilities to prepare them for eventual demolition. Deactivation activities took place at the Low Intensity Test Reactor, known as Building 3005, and the Oak Ridge Research Reactor, known as Building 3042. This work focused on removal of asbestos, lead, and universal wastes.

Deactivation is also underway at a group of buildings called Isotope Row. These facilities were constructed in the 1950s and early 1960s to process radioisotopes. This work also includes asbestos and universal waste removal.

Demolishing these facilities will remove a significant risk from the heart of ORNL and provide land for future research and science missions. Demolition for a number of these facilities is anticipated to begin in FY 2022.



**Workers removing wastes from Building 3005**



## Workers prepare EGCR facility for deactivation

Work during FY 2021 at the Experimental Gas-Cooled Reactor (EGCR) helped prepare the facility for future deactivation crews. Those activities included creating additional entrances and exits for future deactivation crews and completing life safety upgrades inside the facility. A special crew brought a new waterjet technology to cut new doorways through the building's metal exterior. The technology uses water and small garnet pieces to cut through the  $\frac{3}{4}$ -inch thick steel, which was more cost effective and safer for the workers to manage.

To support deactivation crews, workers have prepped the structure for installation of a transport platform system — large elevator-like devices installed outside facilities that allow workers to access multiple floors. Reusing these platforms from another project saved nearly \$3.5 million. When installed, the platforms allow workers to maneuver around the eight-story, 216-foot-high facility more easily.

# MSRE cleanup and life extension upgrades underway

Crews characterized and disposed several waste items from the Molten Salt Reactor Experiment (MSRE) facility—a test reactor that operated at ORNL from June 1965 until December 1969. In FY 2021, OREM disposed waste from the defueling effort that was completed approximately 20 years ago. Four cabinets, along with piping and components and a process flex hose, were removed, packaged, and shipped for disposal.

In FY 2021, EM initiated a pathway for the eventual deactivation and demolition of the MSRE facility. Specific actions taken toward closing the MSRE site include:

- Initiating the installation of the new Continuous Purge System (CPS)

- Moving occupants out of the 7509 office building in preparation for that facility's demolition
- Initiating the installation of an external electrical distribution system for power supply to the 7503 High-bay systems, which will allow the remainder of the facility to be isolated from utilities
- Continuing progress on the MSRE Feasibility Study for a final disposition plan of both facility and components.

Head-space gases from three tanks—two fuel drain tanks (FDTs-1 & 2) and one fuel flush tank (FFT)—are currently allowed to build up to a maximum pressure and pumped down using the Reactive Gas Removal System (RGRS) equipment approximately three times per year. This RGRS system was installed in 1997 and was only intended to be used for six



**Stack installation for the Continuous Purge System at MSRE**



months. Additionally, the system has reached the end of its designed life, emphasizing the need for a new head-space gas treatment system. With MSRE closure in mind, a new CPS was designed to minimize reactive gas inventory at MSRE and eliminate long-term operational activities by creating a continually exhausting system for all three tanks.

The new electrical distribution system (EDS) for and a new roofing structure over the MSRE high-bay will enable the remainder of the MSRE site facilities to begin the deactivation process while protecting those key areas (e.g., the drain tank pit, the reactor cell) that will take longer to disposition. Each of these new installations (EDS and roof) were designed in FY 2021 and are planned to be installed in FY 2022.

## U-233 being processed to disposal-ready form

OREM and its contractor Isotek successfully completed processing and disposing the low-dose inventory of uranium (U)-233 stored at ORNL this year, ending a two-year effort that has eliminated a portion of the site's legacy nuclear material and provided rare nuclear isotopes for next-generation cancer treatment research.

With the low-dose U-233 inventory disposed, OREM and Isotek will focus on treating and disposing the remaining high-dose U-233 inventory stored at ORNL. Eliminating the inventory of U-233 is EM's highest priority at ORNL. U-233 is a manmade isotope created as an alternative nuclear fuel source in the 1950s. The nation's inventory of U-233 was later sent to ORNL for long-term storage.

OREM finished disposing approximately half of the U-233 inventory in 2017, while the remainder of the material required processing and downblending to convert it into a form for safe shipment and disposal.

An initial approach involved processing all of the remaining inventory in heavily shielded rooms, known as hot cells. However, the building where this would occur required significant upgrades before that work could begin.

Isotek identified a subset of the U-233 material with lower radioactivity levels that employees could begin processing in gloveboxes while other crews prepared the hot cells to address the U-233 material with higher

radioactivity levels. This approach was made possible through a unique partnership with TerraPower, a private nuclear innovation company.

Isotek received funds from TerraPower to extract thorium isotopes from the U-233 inventory. Through this arrangement, TerraPower received rare medical isotopes to advance next-generation cancer treatment research, and Isotek received funds it reinvested in the project to purchase gloveboxes and accelerate the processing schedule, saving significant tax dollars.

With upgrades and installation of new equipment complete, Isotek is slated to begin its next phase of the disposition campaign in early 2022 which involves processing canisters with the high-dose U-233 material. The heavily shielded hot cells protect workers and allow them to handle the material using remote manipulators. This upcoming phase will enable Isotek to enhance productivity by processing larger amounts of U-233 and extracting more medical isotopes.



**A worker processes low-dose material**

# LGWO improvements extend life of system

At Liquid and Gaseous Waste Operations (LGWO), OREM is investing \$27 million to conduct significant improvements and upgrades to the gaseous waste system, the liquid low-level waste system, and the process waste system for continued, reliable operations for the years ahead.

Keeping these waste treatment systems functioning and reliable is essential to EM's ongoing cleanup operations and ORNL's laboratories and nuclear-related operations.

Evaporation in the liquid low-level waste system restarted in FY 2021. One of the evaporators received focused attention in 2020 and 2021 after years of nonuse. Every system was evaluated, and many valves, pumps, instruments, and ventilation systems have been repaired or replaced. More than 125,000 gallons of stored low-level liquids were evaporated, creating much needed space in the Bethel Valley storage tanks.

Crews continued to focus on life extension system improvements at the process waste system with the installation of a new backup generator for the process waste pumping stations, installation of an internal liner inside a major underground pipe, replacement of a non-operational pump, stabilization of the zeolite treatment system, and replacement of all above-ground piping at the main process site.



**Piping replacement in the 3608 Building**

As part of that investment, OREM completed construction of a new treatment system that consolidates multiple capabilities into a single facility, and workers began replacing more than a mile of deteriorated carbon steel piping with new stainless steel piping to ensure the system's reliability.



## Y-12 National Security Complex

The Y-12 National Security Complex is a premier manufacturing facility dedicated to protecting our nation. Y-12 helps ensure a safe and reliable nuclear weapons deterrent. The site also retrieves and stores nuclear materials from around the world, fuels the nation's naval reactors, and performs highly skilled, specialized manufacturing for government agencies and private-sector entities.

# Biology Complex demolition completed

It once housed more individuals with doctorates than any facility in the world, but now the final chapter has been written for the Biology Complex. Workers have completed demolition of the sprawling facility, freeing up valuable space for continuing national security missions.

Dating back to the 1940s, the Biology Complex originally consisted of 11 buildings. It was constructed for recovering uranium from process streams and later used for research that led to strides in understanding genetics and the effects of radiation.

Cleanup contractor UCOR brought down the final two building in the complex in FY 2021—the 255,000-square-foot Building 9207 and the

65,000-square-foot Building 9210. The other buildings in the complex have been demolished at different points throughout the past several years, kicking off in 2010 when four of the buildings were brought down with funding from the American Recovery and Reinvestment Act.

The facilities in the Biology Complex presented significant structural risks due to their deteriorated condition, landing them on DOE's list of high-risk excess contaminated facilities.

At the close of the fiscal year, workers were removing the remaining foundations and slabs. The cleared 18-acre site is the planned location for Y-12's future Lithium Processing Facility.



**Equipment tears into Building 9210 as demolition of the facility begins**



**Building 9207 during demolition (above) and after the building was removed (below)**



# Alpha 4 COLEX equipment being deactivated

Alpha-4, also known as Building 9102-4, is one of Y-12's largest high-risk, excess facilities due to its deteriorated condition and mercury contamination. Cleanup contractor UCOR undertook planning to deactivate the four-story, 500,000-square-foot facility and began deactivating one of the two remaining collections of old, mercury contaminated equipment connected to the facility – known as column exchange process (COLEX) equipment.

The Alpha-4 building was originally used for uranium separation from 1944 to 1945. Workers finished installing the COLEX equipment in 1955 for lithium separation operations, a process requiring large amounts of mercury. A significant amount of the mercury was lost into the equipment, buildings, and surrounding soils, and its cleanup is one of EM's top priorities.

In 2018, UCOR demolished the COLEX equipment on the west end of the building after retrieving 4.6 tons of mercury. The effort prevented a possible significant release of mercury into the surrounding environment.

UCOR completed deactivating the COLEX structures on the east end of the building in 2021, and crews captured another 1.25 tons of mercury from cleanup in those pipes and tanks. This project prevents a potential significant environmental release and moves EM a step closer to addressing the Alpha-4 facility.



Workers tap and drain piping at East COLEX

## Deactivation ongoing at unneeded Y-12 facilities



Deactivation activities in Beta-1

Several Y-12 facilities are being deactivated in preparation for eventual demolition. Among them were Alpha-2 (Building 9201-2) and Beta-1 (Building 9204-1). Both of the buildings originally housed calutron tracks for uranium processing for the Manhattan Project. The three-story Alpha-2 building, with a footprint of 107,619 square-feet, is in a cold and dark state, meaning all power sources to the building have been cut.

As workers continued deactivation tasks at Alpha-2, other crews were busy deactivating the multi-level Beta-1 facility, standing on a footprint of 75,012 square feet. Workers removed more than 31 tons of asbestos and universal waste from Alpha-2 and Beta-1 combined.

# Mercury Treatment Facility under construction

Progress continues on construction of the Outfall 200 Mercury Treatment Facility. Excavation activities took place at both the Treatment Plant and Headworks sites. Shoring walls were being installed at the Headworks site during the fiscal year. Crews have poured concrete pads and installed rebar for the walls of the treatment plant.

The facility is the linchpin for OREM's cleanup strategy at Y-12. This vital piece of infrastructure will open

the door for demolition of Y-12's large, deteriorated, mercury-contaminated facilities and subsequent soil remediation by providing a mechanism to limit potential mercury releases into the Upper East Fork Poplar Creek. When operational, the facility will be able to treat 3,000 gallons of water per minute and help Oak Ridge meet regulatory limits in compliance with EPA and state of Tennessee requirements.

The facility is slated to be operational in 2025.



Construction activities for Y-12's new Mercury Treatment Facility



# New technologies will assist in mercury cleanup

Mercury remediation is OREM's highest priority at the Y-12 National Security Complex due to the large losses of the element in buildings, soils, and surface waters in previous decades.

OREM is making significant investments into the development of new remediation technologies to help address the complex mercury challenge at Y-12. In the near-term, mercury technology development activities will support the successful completion of the demolition of Y-12's mercury-contaminated facilities and soils remediation, waste disposition, and reduction of mercury-related ecological risks in East Fork Poplar Creek.

Experiments are underway in ORNL's newly upgraded Aquatic Ecology lab, which provides a testbed for evaluating the effectiveness of remediation technologies in a flow-through system using actual water from East Fork Poplar Creek.

This upgrade allows for the testing of technologies beyond the bench-scale and creates a more environmentally relevant testing conditions to ensure greater effectiveness when remediation strategies are implemented in the field.

Researchers have conducted studies to evaluate alternative treatment chemicals on mercury flux, the effect of sorbents on mercury and methylmercury concentrations in the presence of dissolved organic matter, and the use of mussels as a tool for reducing mercury in the water column. ORNL scientists have prepared a report titled "Mercury Remediation Technology Development for Lower East Fork Poplar Creek—FY 2021 Update." This report provides a detailed description of each of the study areas and findings from studies performed in FY 2021. In the downstream environment, field characterization and research undertaken during the 2015-2021 time period will support an evaluation of potential remediation alternatives for the creek in the mid-2020s.

In FY 2021, a new task was added that focuses on understanding how periphyton, a complex assemblage of algae and bacteria, varies with space, time, and other environmental variables (light, nutrients, etc.) in stream environments. Periphyton have been recognized to play a major role in mercury methylation



and bioaccumulation, but the factors controlling periphyton abundance are not well understood. Unmanned aerial vehicles equipped with sensors were used to better understand the spatial coverage of periphyton in mercury-contaminated streams.

A decision support tool was developed that uses a spatially explicit watershed model to simulate various remediation and technology development scenarios and better inform future remedial decision-making. With a better understanding of mercury transport processes in the watershed system, specific technologies and strategies can be assessed and implemented to aid future cleanup.

In addition to the technology development activities, efforts have been initiated to identify and demonstrate emerging technologies to aid in addressing the mercury challenges. A mercury review committee has been chartered and consists of members from DOE, its contractors, and subject matter experts. The committee serves as the primary resource to evaluate and select proposed new technologies for relevance and potential value, to help identify key technology needs for mercury projects at Y-12, to determine priorities and timing for demonstrations, and to evaluate demonstration results.

As part of the technology demonstration initiative, an evaluation of establishing a facility for demonstration of mercury-related technologies and techniques is ongoing. A conceptual report has been prepared that outlines the modifications needed to utilize an existing facility on the Oak Ridge Reservation as a location for the technology demonstration facility.



## Waste Management

Wastes generated from cleanup activities on the Oak Ridge Reservation are addressed in a variety of ways. Most of the volume is disposed onsite in the Environmental Management Waste Management Facility (EMWMF) or the Oak Ridge Reservation Landfills. However, the highly contaminated material is shipped offsite. Wastewater is treated at various facilities on the Oak Ridge Reservation.

# Most generated wastes safely disposed onsite

Most of the waste generated during FY 2021 cleanup activities in Oak Ridge went to disposal facilities on the Oak Ridge Reservation – namely, the Environmental Management Waste Management Facility (EMWMF) landfill and the Oak Ridge Reservation Landfills (ORRL). These landfills are owned by DOE and operated/maintained by UCOR. These onsite disposal facilities have been vital to cleanup progress and success, enabling OREM to accomplish more cleanup by avoiding costly and unnecessary cross-country shipments. This approach focuses resources on projects that mitigate risks across the Oak Ridge Reservation.

The EMWMF landfill consists of six disposal cells that only receive low-level radioactive and hazardous waste meeting specific criteria. The waste mostly soil and building debris. In FY 2021, EMWMF received 9,546 waste shipments from cleanup projects at ETTP, ORNL, and Y-12, plus 124 clean fill shipments for expanding the enhanced operational cover expansion and constructing access roads and dump ramps. The EMWMF landfill has a design capacity of 2.331 million cubic yards and is now over 80% filled.

EMWMF generated 17.17 million gallons of waste water in FY 2021. Approximately 3.52 million gallons of leachate (water that enters the leachate collection system) was transported by tanker to the ORNL

Liquid and Gaseous Waste Operations for treatment and release. Approximately 14.65 million gallons of contact water (water that contacts waste but does not enter the leachate collection system) was released to Bear Creek after laboratory analysis verified it met all regulatory limits and discharge standards.

The ORRL accepts sanitary/industrial waste and construction/demolition debris. In FY 2021, a record disposal year, these three active landfills received 11,840 waste shipments, totaling 145,292 cubic yards of waste.

The ORRL also manages non-regulated leachate. In FY 2021, the ORRL discharged a total of 4.7 million gallons of leachate from the three active landfills. Operations continued to work with regulatory agencies on seep mitigations for Sanitary Landfill II, a closed landfill, and active Landfill VII.

In FY 2021, OREM implemented extensive measures to maintain and improve sediment and erosion controls at the ORRL. These measures included upgrading drainage features, which significantly reduces the amount of sediment released from these landfills. The TDEC inspections in FY 2021 noted excellent sediment and erosion controls with no Areas of Concern or Violations.





EMWMF will reach capacity in the near term before OREM completes its cleanup at Y-12 and ORNL.

Planning continued in FY 2021 for another disposal facility that is needed to provide the capacity required to complete Oak Ridge's cleanup. The new facility will be called the Environmental Management Disposal Facility (EMDF).

OREM continued to monitor a total of 31 wells at the proposed site for the disposal facility (measuring and recording water levels and groundwater characteristic data) for the entire year.

The *DOE O 435.1 Preliminary Disposal Statement* was issued by DOE headquarters following successful EM-4 review of the project. The *DOE O 413.3 Project Peer Review* was successfully completed.

OREM continues to work with EPA and TDEC to move forward on regulatory documents related to the project. The Record of Decision was prepared and submitted for regulator review in July 2021. Planning for the groundwater field demonstration that will augment the existing site characterization is in progress, including the demonstration design.

## TWPC continues waste processing, shipments

North Wind Solutions, LLC, operator of the Transuranic (TRU) Waste Processing Center (TWPC), continued processing and shipping TRU, mixed low-level waste (MLLW), and low-level waste (LLW) in FY 2021.

TWPC's operational focus in FY 2021 was focused on readiness preparation to commission a new remote waste processing capability at TWPC, which will be used to disposition over 50% of the remaining 39 cubic meters of the TRU Waste Legacy Inventory.

TWPC continued limited processing operations and completed remediation and treatment of a

total of 11 cubic meters of contact- and remote-handled TRU waste, as well as macro-encapsulation of mixed low-level waste.

This year, TWPC continued shipments of TRU waste to the Waste Isolation Pilot Plant and eliminating the inventory stored on site. EM shipped 159 cubic meters, accounting for 756 containers, of processed TRU waste to WIPP in FY 2021.

Comprehensively, the TWPC facility has completed processing of 98% and shipment of 78% of the Oak Ridge Reservation Site Treatment Plan contact- and remote-handled TRU waste lifecycle legacy inventory.

## Construction underway on sludge processing facility

Construction is underway on the Sludge Processing Mock Test Facility, which will play a vital role in maturing technologies needed to begin processing Oak Ridge's 500,000-gallon inventory of TRU sludge waste.

OREM has been working since 2003 to process, repackage, and ship Oak Ridge's inventory of transuranic debris waste for permanent disposal at WIPP. With that processing nearing completion, OREM is now working to address the site's inventory of TRU sludge waste.

OREM will test six critical technology elements to gather the data necessary to complete the final design and construction of the Sludge Processing Facility later this decade. Two of those technologies will be tested at the mock test facility.

This facility will be used to test pump technologies and instrumentation measurement technologies. Advanced pump technologies are needed to pull the sludge wastes out of their storage tanks for processing. The instrumentation measurement technologies will inform operators what material is moving through the pumps, including its contents and density, to assist with processing needs.

## Wastewater treatment helps facilitate cleanup

Each year, activities on the Oak Ridge Reservation generate millions of gallons of wastewater that must be treated to remove oil, chemicals, radiological constituents, and other contaminants.

Y-12 treats wastewater and groundwater generated from production and environmental cleanup activities. The site provided safe and compliant treatment of approximately 62 million gallons of wastewater and groundwater during FY 2021.

At ORNL, the Process Waste Treatment Complex treated approximately 89 million gallons of wastewater in FY 2021.

In addition, the liquid low-level waste system at ORNL received approximately 40,604 gallons for treatment.

The ORNL 3039 Stack Facility treated 0.84 billion cubic meters of gaseous waste. These waste treatment activities supported both OREM and DOE Office of Science mission activities safely and compliantly.

## Monitoring ensuring effectiveness of controls

OREM continued to implement its groundwater strategy for the Oak Ridge Reservation in FY 2021. Three groundwater exit pathway wells have been installed in west Bethel Valley near the Clinch River.

Exit pathways are areas where contaminants have the potential to exit the Oak Ridge Reservation to offsite areas. In FY 2021, multi-zone monitoring equipment was installed in each of the three locations to allow multiple sampling zones to be monitored across the vertical profile of a single monitoring well. Monitoring of the new wells that began in FY 2021 will supplement

current exit pathway monitoring and offsite monitoring.

Also in FY 2021, OREM completed the 2021 fifth CERCLA Five-Year Review for the U.S. Department of Energy Oak Ridge Site. The objective of the Five-Year Review is to evaluate the success of completed CERCLA remedial actions in protecting human health and the environment. The document identifies any potential issues related to the current status of the implemented actions and recommends follow-up actions to ensure protectiveness.



## Public Involvement

The public is involved in all cleanup decisions made by DOE. To keep the public informed, DOE provides information through a variety of outlets, including tours, meetings, briefings, conferences, media outreach, fact sheets, public notices, websites, social media, and various publications.



## Advisory board provides public input on DOE cleanup activities

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The Oak Ridge Site Specific Advisory Board (ORSSAB) is a federally chartered volunteer citizens panel that provides independent advice and recommendations to OREM. ORSSAB provides DOE and regulators at the U.S. Environmental Protection Agency (EPA) and the Tennessee Department of Environment and Conservation (TDEC) with a forum for understanding stakeholder perspectives. It also serves as a venue for members of the community to express their views or ask questions.

Since 1995, ORSSAB has provided 248 recommendations to OREM on important aspects of the cleanup program, such as land use and reindustrialization; stewardship; cleanup standards, activities, and budgets; and waste management. Every major record of decision (ROD) developed under EM has had heavy SSAB involvement, and none of the final RODs have been at odds with majority SSAB opinions.

ORSSAB may have up to 22 members. Individuals apply for membership and are selected annually by DOE to reflect a diversity of interests, gender, race, and other criteria of persons in the multi-county area that surrounds the Oak Ridge Reservation. Technical expertise is not a requirement for membership, although some members may have those skills. DOE strives to have a good mix of educational backgrounds among members.

The board conducts an annual recruitment event but welcomes applicants to submit their information at any time through its website. Becoming a board member is a key way to represent your community, share feedback, and ask questions about OREM's cleanup projects.

In 2021, the board issued a recommendation on the site's budget request; discussed ongoing development of the planned new onsite waste disposal facility, EMDF; and provided input on future groundwater remedies at ETP. Similarly, the primary way

individuals can learn about the latest cleanup efforts is by attending board meetings. Meetings offer a unique opportunity to interact with OREM experts who lead the cleanup effort as they present progress updates and answer questions directly.

ORSSAB normally meets the second Wednesday of most months at 6 p.m. at the DOE Information Center located at 1 Science.gov Way in Oak Ridge. During 2021 and until further notice, meetings have been conducted virtually through Zoom. The board also has two standing committees and those meetings are also open to the public. The Executive Committee meets the first Wednesday of most months at 5 p.m. at the DOE Information Center (or virtually as needed) to discuss board business including upcoming meeting logistics, member training, and membership recruitment. The EM & Stewardship Committee meets at 6 p.m. on the fourth Wednesday of most months at the DOE Information Center (or virtually as needed) to conduct in-depth discussion of the monthly meeting topic and work to craft recommendations to DOE.

Meetings are always open to the public and include time for public comment, however, ORSSAB offers additional opportunities outside of these events for the public to learn about OREM's cleanup mission. The board regularly issues news releases, advertises in local media, broadcasts a portion of its monthly meetings on local cable stations, and archives meeting presentation video to its YouTube channel, [www.youtube.com/user/ORSSAB](https://www.youtube.com/user/ORSSAB). Staff maintain an active social media presence at [www.facebook.com/ORSSAB](https://www.facebook.com/ORSSAB). The board also publishes a weekly email newsletter and a quarterly print and electronic publication, the Advocate. Board members and staff are available on request to educate community groups and organizations about the board's function and activities. Sign up for any of these items by emailing [orssab@orem.doe.gov](mailto:orssab@orem.doe.gov). More information about the board and its activities is available at [www.energy.gov/](https://www.energy.gov/)



**ORSSAB  
members**

## DOE Information Center



The DOE Information Center is located at the Office  
of Scientific and Technical Information,  
Building 1916 – T1,  
1 Science.gov Way, Oak Ridge, Tennessee 37831  
E-mail: [doeic@science.doe.gov](mailto:doeic@science.doe.gov)  
Hours: 8 a.m. to 5 p.m., Monday – Friday  
<http://doeic.science.energy.gov>  
Phone: (865) 241-4780

### FY 2021 Stats

|   |        |
|---|--------|
| Total citizen inquiries                 | 505    |
| Total number of documents at the center | 58,130 |
| Total number of documents online        | 18,699 |

# Websites for Additional Information

DOE OREM Public Information  
(865) 574-4912  
[www.energy.gov/orem](http://www.energy.gov/orem)

Oak Ridge Site Specific Advisory Board  
(865) 241-4583, (865) 241-4584  
1-800-382-6938  
[www.energy.gov/orssab](http://www.energy.gov/orssab)

Tennessee Department of Environment  
and Conservation–DOE Oversight Office  
(865) 481-0995  
<https://tdec.tn.gov/>

U.S. Environmental Protection Agency  
Region 4  
1-800-241-1754  
[www.epa.gov/aboutepa/about-epa-region-4-southeast](http://www.epa.gov/aboutepa/about-epa-region-4-southeast)

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## Commonly Used Acronyms

|        |   |
|--------|---|
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act of 1980 |
| COLEX  | Column Exchange   |
| CROET  | Community Reuse Organization of East Tennessee                                |
| DOE    | U.S. Department of Energy   |
| EM     | Environmental Management  |
| EMDF   | Environmental Management Disposal Facility                                    |
| EMWMF  | Environmental Management Waste Management Facility                            |
| EPA    | U.S. Environmental Protection Agency  |
| ETTP   | East Tennessee Technology Park  |
| EU     | Exposure Unit   |
| FAA    | Federal Aviation Administration   |
| FY     | Fiscal year   |
| LGWO   | Liquid and Gaseous Waste Operations   |
| LLLW   | Liquid Low Level Waste  |
| MSRE   | Molten Salt Reactor Experiment  |
| OREM   | Oak Ridge Office of Environmental Management                                  |
| ORNL   | Oak Ridge National Laboratory   |
| ORSSAB | Oak Ridge Site Specific Advisory Board  |
| ROD    | Record of Decision  |
| TDEC   | Tennessee Department of Environment and Conservation                          |
| TRU    | Transuranic   |
| TWPC   | Transuranic Waste Processing Center   |
| U-233  | Uranium 233   |
| WIPP   | Waste Isolation Pilot Plant   |

# Commonly Used Terms

**CERCLA:** The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) established prohibitions and requirements concerning closed and abandoned hazardous waste sites, provided for liability of persons responsible for hazardous waste releases at these sites, and established a trust fund to provide cleanup when no responsible party could be identified. The law, which governs cleanup operations on the Oak Ridge Reservation, authorizes two kinds of response actions: short-term removal actions, where actions may be taken to address releases or threatened releases requiring prompt response, and long-term remedial actions, which permanently and significantly reduce the dangers associated with releases or threats of releases. Long-term actions can be conducted at sites on the U.S. Environmental Protection Agency's National Priorities List, a listing of the nation's most hazardous waste sites. The Oak Ridge Reservation was added to that list in 1989.

**Federal Facility Agreement:** CERCLA requires an agreement between state and federal entities to guide cleanup work at CERCLA sites. For the DOE Oak Ridge Office, the parties of this agreement, called a Federal Facility Agreement, is DOE, the U.S. Environmental Protection Agency, and the Tennessee Department of Environment and Conservation. The Federal Facility Agreement for Oak Ridge was initiated in January 1992.

**Removal Actions:** Some cleanup activities on the Oak Ridge Reservation are conducted as Removal Actions under CERCLA. These actions provide an important method for moving sites more quickly through the CERCLA process. When a site presents a relatively time-sensitive, non-complex problem that can and should be addressed, a Removal Action would be warranted.

**Remedial Actions:** Remedial actions are long-term response actions that seek to permanently and significantly reduce the risks associated with the release or threat of release of hazardous substances.

**Remedial Investigation/Feasibility Study:** The purpose of the remedial investigation/feasibility study (RI/FS) is to assess site conditions and evaluate alternatives to the extent necessary to select a remedy. Developing and conducting an RI/FS generally includes the following activities: project scoping, data collection, risk assessments, treatability studies, and analysis of alternatives. The scope and timing of these activities should be tailored to the nature and complexity of the problem and the response alternatives being considered.

**Record of Decision:** Under the CERCLA process, a Record of Decision formally documents the selection of a preferred cleanup method after a series of steps, including an RI/FS. A preferred cleanup alternative is selected and presented to the public for comment in a Proposed Plan. EPA, the state, and the lead agency then select a remedy and document it in the ROD.

**Fiscal Year:** The 2021 fiscal year spans from Oct. 1, 2020, to Sept. 30, 2021.

For more information, please contact  
the DOE Oak Ridge Public Affairs Office at (865) 574-4912.